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EREP MONTHLY PROGRESS REPORT - NUMBER 9

Period: December 16, 1973, to January 15, 1974

INVENTORY OF FOREST AND RANGELAND RESOURCES, INCLUDING FOREST STRESS

Registration No. 418

Contract No. T4106B

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Coinvestigators: Robert C. Aldrich
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A. Overall Status

1. Atlanta, Georgia, - forest inventory site (512)

Bad weather and low sun angle prevented any Skylab data from being collected over this site on January 5, 10, and 15. Six men were present on the site to measure reflectance, incoming radiation, and to photograph on the ground representative forest and land use types.

The silicon vidicon camera and associated radiometer were flown over the Georgia site on January 13, 1974 in anticipation of a January 15 EREP pass. Clear skies and excellent visibility provided optimum conditions for the S-190-matched measurements of radiance and reflectance at an altitude of 1000 feet. The pulse generator that was to synchronize the video tape data with chart-recorded radiance did not function correctly. However, there were sufficient landmarks with recognizable signatures on both television monitors (as well as spoken microphone inputs) to allow adequate coordination. As no EREP pass was performed, it was necessary to prepare for a subsequent flight in the California area where passes were planned for tracks 6 and 63 on January 26 and 27, respectively. The Georgia data has not been analyzed because of no comparative Skylab data.

This site has not received any overpasses by Skylab or NASA supporting aircraft since the contract began. Bad weather, EREP operational difficulties and displacement of the ground track on SL-2 and SL-3 have prevented our getting any data over our instrumented site.

2. Black Hills, South Dakota - forest stress site (312)

SL-3 photography of the Black Hills test site was received for September 13, 1973, day 256. Although the weather over the instrumented portion of the test site was overcast at the time of the SL-3 pass, the area west of the 104° meridian was clear and thus provided acceptable coverage of the Bear Lodge mountains which are a western extension of the Black Hills ponderosa pine ecosystem. A preview of the S190-B imagery indicates that some of the bark beetle infestations, which were plotted in an aerial reconnaissance flight on September 18, 1973, can be identified. This is of particular interest in that the Bear Lodge infestations are much smaller in size and somewhat more widely scattered than those plotted on SL-2 imagery over the main part of the Black Hills.

At this point it is doubtful that the S190-A photography (SL-3) will yield significant data. This is because of the intense cloud cover over most of the area, which in turn oversaturates the field of view and causes the details of vegetation to be obscured by under exposure. However, the S190-B photography is going to make an important contribution to the Skylab study in terms of determining the detectability of forest stress. While the imagery taken during SL-2 was obtained under nearly perfect weather conditions, timing was poor from the standpoint of stress detection in the Black Hills ecosystem. Further, the timing of the SL-3 imagery was ideal from the standpoint of detecting stress, but unfortunately most of the Black Hills test site, where the majority of the pre-experiment information was obtained, went unobserved by EREP. If the SL-4 imagery over this site is as good as described by the astronauts and appeared on the ground TV console, there is no reason why most of the proposed goals of the Black Hills stress investigation cannot be realized. We would do this by using a composite of all three mission data sets.

On the return trip from the Atlanta site, we stopped in Houston and were provided the opportunity to view multispectral scanner imagery of SL-2 (S192) and Mission 247 (C-130 MSS). A rather complex hookup was established between the 418 processor and the EREP's console thru the ADTE system for enhancement screening of two simultaneous channels of imagery. It was determined that the best data from S192 were contained in the following bands:

<u>MSS Band</u>	<u>Description</u>	<u>Spectral range</u>
3	Blue-green	0.52 to 0.56 μ m
6	Red	0.68 to 0.76 μ m
8	Infrared	0.98 to 1.03 μ m
12	Infrared	2.10 to 2.35 μ m

It was further determined that the existence of band 13 (in properly rectified form and without noise problems) would greatly improve the proposed MSS processing and analysis. We therefore requested that the delivery of DPAR 192-270-02-06-55-2 be delayed until good quality thermal data (band 13) can be included for processing.

Having viewed both aircraft and satellite MSS imagery on the EREP's console, we strongly suggest that some provision be made in the future for interested investigators to preview their imagery in a like manner so that they can make intelligent requests for processing of the data. Without having viewed the imagery at Houston, we would have made poor guesses on the proper processing rationale on the basis of the data sent to us in Berkeley (channels 2, 7, and 11).

After viewing mission 247 MSS imagery on the EREP's console specifications were completed for DAS processing at Houston. Preliminary color composites have been received and evaluated. The original DAS configuration was as follows:

<u>MSS Channel</u>	<u>Wavelength</u>	<u>DAS Filter</u>	<u>Enhancement Coefficient</u>
4	0.54 to 0.58 μ m	Blue	0.45
5	0.59 to 0.64 μ m	Green	0.97
9	0.83 to 0.88 μ m	Red	0.72

The first iteration was completed with a brightness coefficient of 7.15. After viewing the processing results the following adjustments were made to the processing specifications:

4	0.54 to 0.58 μ m	Blue	0.45
5	0.59 to 0.64 μ m	Green	0.97
8	0.77 to 0.81 μ m	Red	0.70

The brightness coefficient for this attempt was 7.20. Results of the second effort appear to be very satisfactory. At the present time we are making PCM count correlations to actual tree counts (of beetle killed ponderosa pine) on the large scale (1:4,700 scale and 1:15,000 scale) color infrared photographs. A very helpful innovation to the DAS output format was the addition of a one-half inch grid system which is used for pin pointing the location of dead pines.

3. Manitou, Colorado - range inventory site (313)

The total data products on hand for our investigation has not changed since our last reporting period. The following summarizes the data products we now have for both the SL-2 and SL-3 overpasses.

SL-2: S190A photographic products. To our knowledge this is the only data secured and available for site 313.

SL-3: S190A - camera correlation report. No photographic products.
S190B - camera correlation report. No photographic products.
S191 - boresight camera pulse correlation. No data products.
S192 - field-of-view tabulations. Screening imagery for channels 2, 7, and 11. Computer compatible tapes.

Precision measurements of amounts of live plant material, plant litter, and bare ground are being made from large-scale sampling photographs of selected grassland areas using the microdensitometer. These measurements together with image characteristics derived from small-scale aircraft (MX 239 and MX 248) and Skylab photographs, should provide inferences on the threshold of the spectral response of live grassland vegetation beyond which this response is minimized. It will also provide the base information the first step above absolute ground truth, for developing subsampling techniques to estimate these parameters from the small-scale aircraft and Skylab products.

Transfer of interpretation training and testing cells from base topographic sheets to MX 239 and MX 248 photographs, is about 10 percent complete. These cells will be used for plant community classification according to the following:

<u>Forest types</u>	<u>Hydrophitic</u>	<u>Upland grassland</u>
Ponderosa pine	Sedge/rush meadows	Mountain bunchgrass
Douglas-fir	Grass meadows	Shortgrass
Spruce/fir	Shrub meadows	
Lodgepole pine		
Aspen		

B. Recommendations concerning decisions required to ensure attainment of experiment's scientific objectives:

1. Atlanta, Georgia - forest inventory site (512)

A representative of the remote sensing project will go to the JSC in Houston to review photographic data collected by SL-2, 3, and 4 in the southeastern United States. The area selected should correspond to areas where recent Forest Survey data have been collected on the ground. This will have to be done to replace the extensive ground data taken in anticipation of coverage by EREF over the present site.

2. Manitou, Colorado - range inventory site (313)

Due to the delay in receiving SL-3 photographic products, we may request a time extension on the contract to allow for adequate data processing, analysis, and reporting. Also, and in connection with Site 312, we may need to realign our plans for using S191 and S192 data once it is known with certainty the material is available for all three sites.

C. Expected accomplishments.

1. Black Hills, South Dakota - forest stress site (312)

During the next reporting period we plan to make the infestation spot correlations between SL-3, S190-B, photography and the results of the aerial reconnaissance of the Bear Lodge mountains. We hope to report the relationship between detectivity for spot size, aspect, and relative radiance contrast. We hope to accomplish this effort using the zoom transfer scope and the Variscan viewer.

We are hoping to receive the final results of DAS processing of the MX 247 MSS imagery. At that time we will establish the correlations between PCM counts for dead ponderosa pine and actual numbers of dead trees. Although the correlations are expected to be much different for the low and high altitude flights, we hope to establish a separate tree count equation for both.

2. Manitou, Colorado - range inventory site (313)

Once enlargements of SL-2 S190A photographs are in hand (they are now being processed), we should be in position to make relative statements about the use of that material for plant community classification. Provided work progresses as planned, we should also be able to make comparative statements about the level of aircraft support required for quantitative plant community analysis using Skylab and supporting aircraft data.

D. Significant results, practical applications, and operational problems.

1. Atlanta, Georgia - forest inventory site (512)

No Skylab data have been collected over our Atlanta test site and this poses a delay and possible negation of the entire forest inventory part of the experiment.

2. Black Hills, South Dakota - forest stress site (312)

Some current beetle-killed ponderosa pine can be detected on S190-B photography imaged over the Bear Lodge mountains of the Black Hills National Forest. Detections were made on SL-3 imagery (September 13, 1973) using a

zoom lens microscope to view the photography. At this time we have not made correlations to all of the known infestation spots in the Bear Lodge mountains, rather we have simply located known infestations on the SL-3 imagery. It was determined that the beetle-killed trees were current kills by stereo viewing of SL-3 imagery on one side and SL-2 on the other.

A successful technique was developed for mapping current beetle-killed pine using MSS imagery from mission 247 flown by the C-130 over the Black Hills test site in September 1973. Color enhancement processing on the NASA/JSC, DAS system using three MSS channels produced an excellent quality detection map for current kill pine. More importantly it provides a way to inventory the dead trees by relating PCM counts to actual numbers of dead trees.

E. Travel plans, January 16, 1974 to February 16, 1974.

A silicon vidicon flight will be made over GT's 6 or 63 on January 26 or 27, 1974 depending upon weather and coordination with NASA aircraft overflights. Four men are required on a 4- to 5-hour mission in the Forest Service aircraft.

Aldrich or Greentree will examine S190A imagery at JSC and check availability of simultaneous aircraft imagery over a selected area in southeastern United States. Round trip plane fare (\$255.00) and 5 days per diem (\$125.00) will be required.